

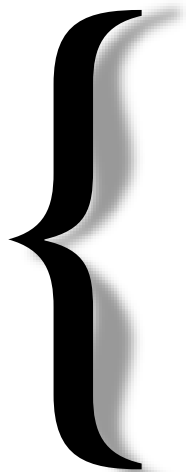
MICROPROCESSORS, PROGRAMMING AND INTERFACING
(CS F241)



CASH REGISTERS



GROUP 50



Shanay Gandhi (2020B2A72072G)

Tejas Khadke (2020B4AA0758G)

Kushal Maheshwari (2020B4A71955G)

Devansh Agarwal (2020B4A71588G)

Hrushikesh Kadam (2020B4A71093G)

Shrey Mehta (2020B3A71459G)

ACKNOWLEDGMENT

We would like to extend our heartfelt appreciation to Professor K. R. Anupama for her invaluable contribution to our project. Her expert guidance, insights, and support have been crucial in shaping our approach and understanding, and her willingness to offer her time and feedback has been a source of inspiration to us all.

PROBLEM STATEMENT

- The system to be designed is a Cash Register a modified form of the one available in the institute cafeteria.
- The system is a stand-alone with inputs provides via a keyboard. Outputs are available via a LCD display.
- System gets power via the standard power outlet.
- System has chargeable battery available with it, that is used a battery back-up of the RAM. The battery charges itself when the system is on. A fully-charged battery has a life-time of 36 hours.

System Requirements:

1. Keyboard

0	1	2	3	4	5	6	7	8	9	Y	N
Enter		Backspace		Cancel		Item No.		Quantity		Total	
Mode		Trans		Program		Add Item		Del Item		Cost	

- ### 2. Display- A Liquid Crystal Display. Size of the Display is 16 x 1. (16 characters on one line). The LCD is connected to the micro-controller through a display driver in this case HD44780 which is available with the LCD.

ASSUMPTIONS

1. Quantity is 1 digit number, Price is 2 digit number, Item Code is 2 digit number.
2. Only one key is pressed at a certain time.
3. User is expected to know the order of keys to be pressed to execute a certain function.
4. System is locked at the beginning.
5. Item code will always be in two digits, starting from 00 to 99.
6. Backspace is only valid if a value is entered.
7. Delete item is only used for existing and valid item codes.
8. Buzzer works for 1 minute exactly. Only after that the lock can be opened.
9. When the system is locked, if the user tries to press a key, IR0 interrupt is raised which is the highest priority interrupt to start the buzzer for one minute. We do not set interrupt flag during ISR so no other interrupt is raised.
10. Keyboard interrupt is IR1.

COMPONENTS

SR NO.	COMPONENT NAME	NO OF COMPONENTS	DESCRIPTION
1.	8086	1	16 bit Intel microprocessor
2.	8254	1	Since 4kHz is required to start the clock for the buzzer, it is within the range of 8254 input range (up to 10MHz).
3.	8255	2	1. The keyboard for user has been interfaced as a 6x4 keyboard. Input ports are Port C and output ports are Port A.
			2. Second 8255 is used to program LCD display.
4.	8259	1	To give priority interrupts
5.	8284	1	To generate clock for microprocessor and 8254
6.	HD44780	1	Display driver for LCD JHD162A
7.	74LS138	1	3x8 Decoder
8.	2716 - ROM	4	Smallest ROM chip available is 2K and initial 2K from address 00000H for IVT. Microprocessor resets at
9.	6116 - RAM	2	Smallest RAM chip available is 2K and we need odd and even bank. We need RAM for stack and temporary storage of data
10.	74LS373	3	3-STATE Octal D-Type Transparent Latches and Edge-Triggered Flip-Flops

11.	74LS245	2	Octal Bus Transceivers With 3-State Outputs
12.	74LS244	1	Octal Buffers and Line Drivers With 3-State Outputs
13.	7404	1	NOT Gates
14.	7408	2	AND Gates
15.	7432	2	OR Gates

ADDRESS MAPPING

1. Memory Addressing-

RAM – minimum 2k chip- 4k

ROM - minimum 2k chip – 4k x 2




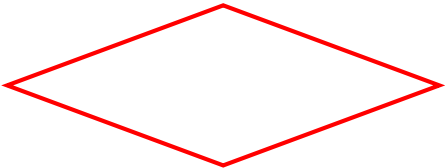

ROM/RAM	STARTING ADDRESS	ENDING ADDRESS
ROM1	00000H	00FFFH
RAM1	01000H	01FFFH
ROM2	FF000H	FFFFFH

2. I/O Addressing-

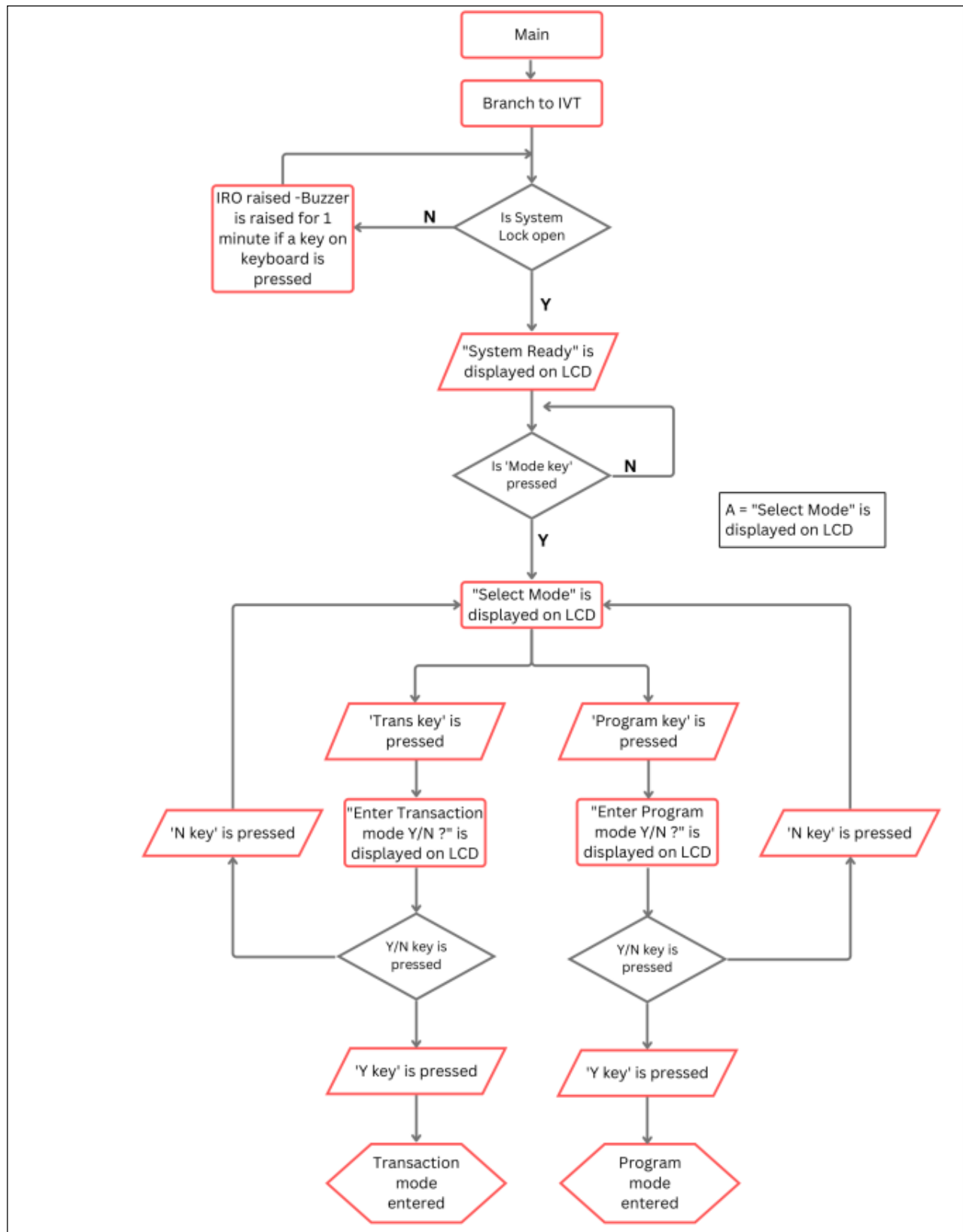
CHIP	PORT	ADDRESS
8255-1 (LCD)	Port A	00H
	Port B	02H
	Port C	04H
	Control Register	06H
8255-2 (Keyboard)	Port A	08H
	Port B	0AH
	Port C	0CH
	Control Register	0EH
8254	Counter 0	10H
	Counter 1	12H
	Counter 2	14H
	Control Register	16H
8259	1st addressable location	18H
	2nd addressable location	1AH

FLOWCHARTS

Flowchart Legend:

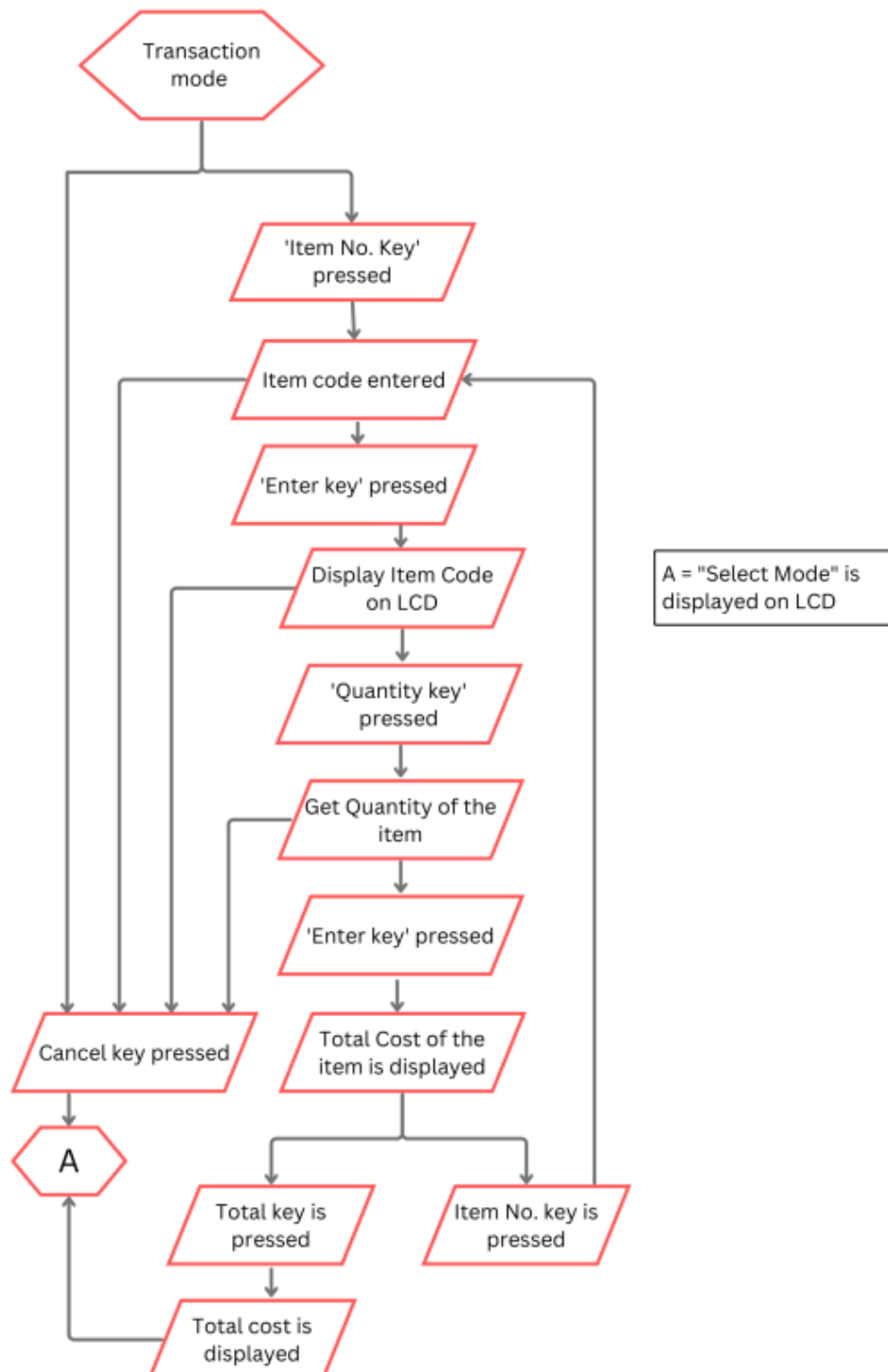
SYMBOL	MEANING
	Starting or Ending point (Terminator)
	Process
	Input/Output
	Decision
	Off-Page Reference (To continue the flow on a new page)

Main Flowchart:

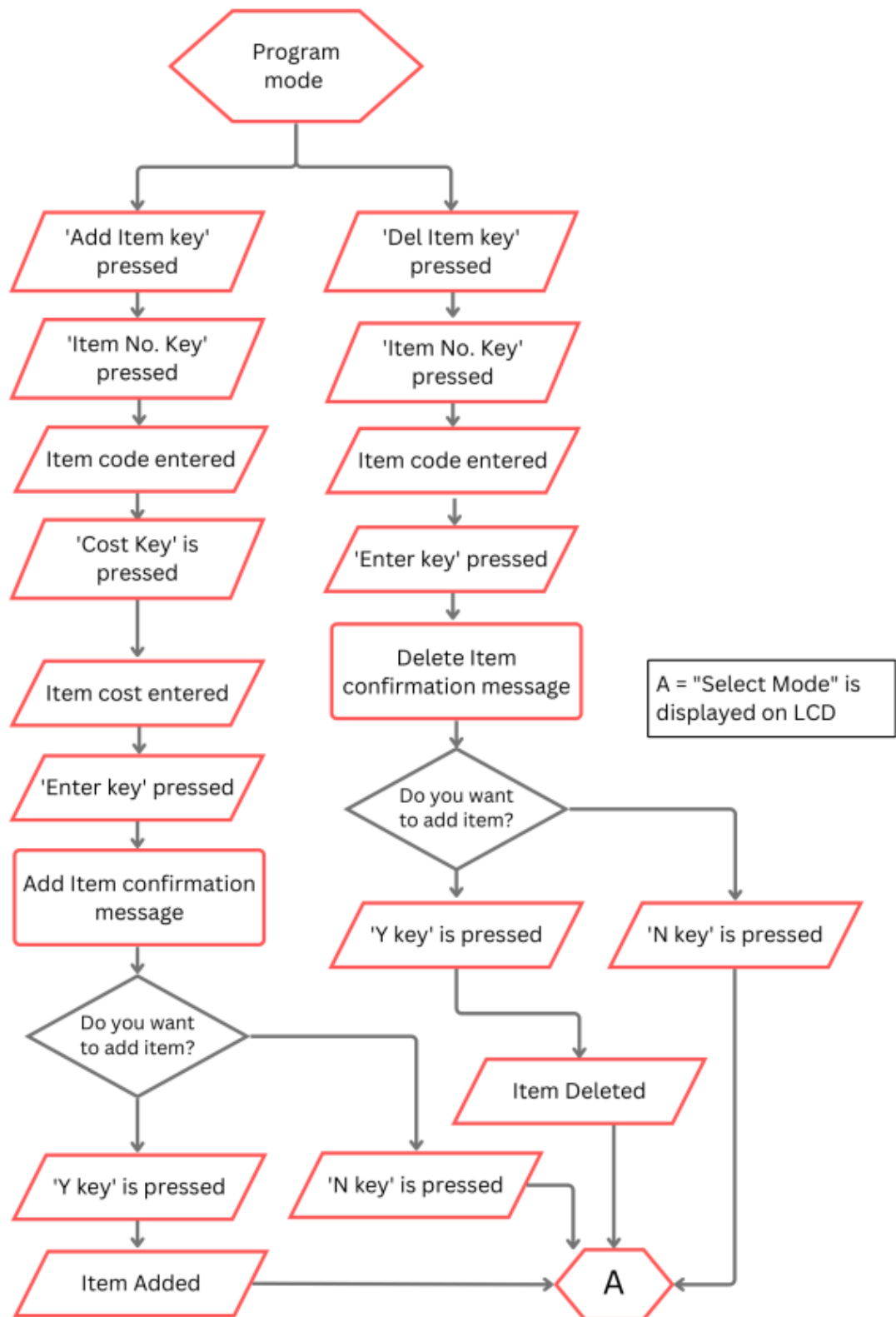


Note: Every time a key is pressed, IR1 is pressed.

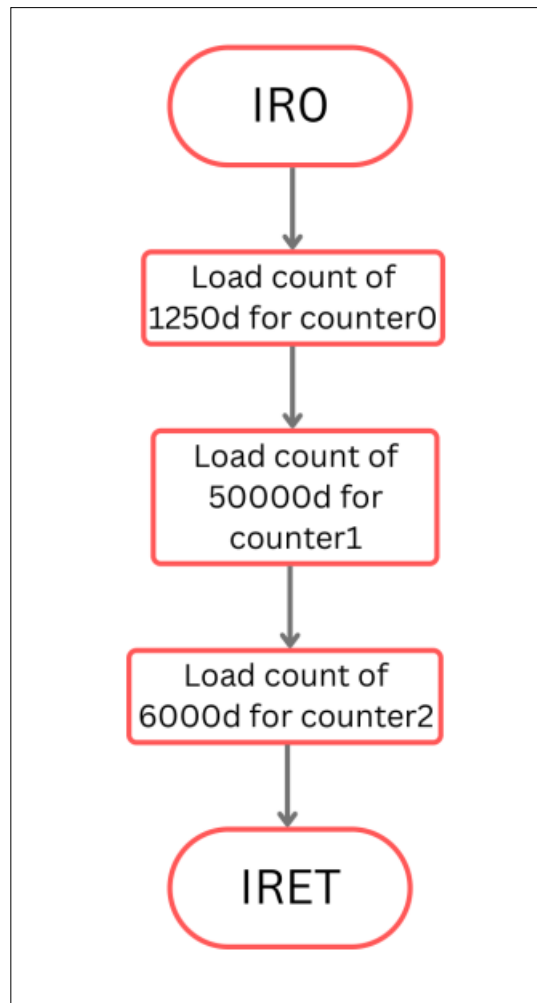
Transaction Mode:



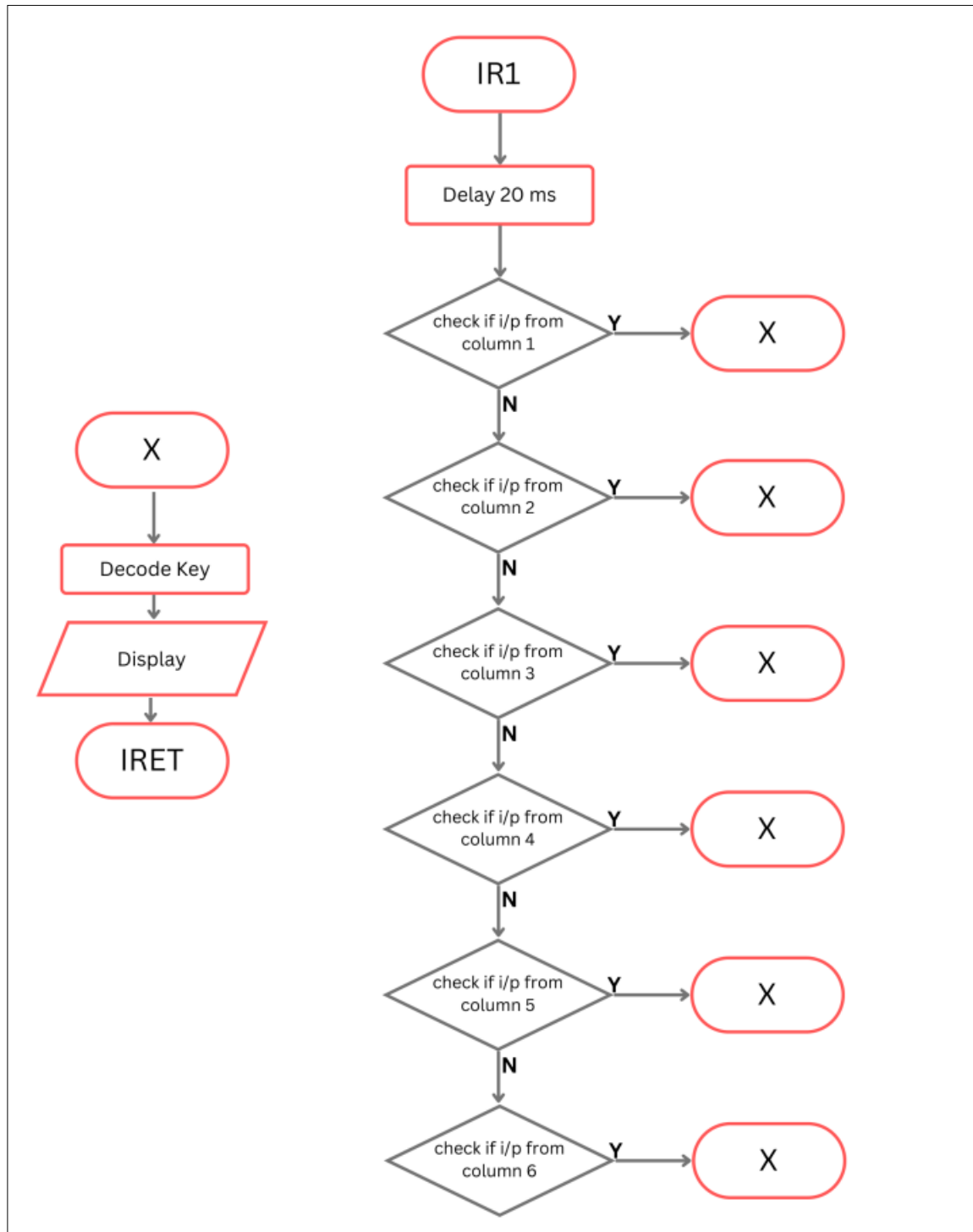
Program Mode:



Interrupt IRO:



Interrupt IR1:



DATASHEETS:

- 8086- https://www.electro-tech-online.com/datasheets/8086_intel.pdf
- 8255- <http://aturing.umcs.maine.edu/~meadow/courses/cos335/Intel8255A.pdf>
- 8254- <https://www.scs.stanford.edu/10wi-cs140/pintos/specs/8254.pdf>
- 8284- <https://datasheet.octopart.com/D8284A-AMD-datasheet-37652453.pdf>
- 8259- <https://www.renesas.com/us/en/document/dst/82c59a-datasheet>
- 2716- <https://amigan.yatho.com/2716EPROM.pdf>
- 6116- <http://www.princeton.edu/~mae412/HANDOUTS/Datasheets/6116.pdf>
- 74LS373- <https://www.ti.com/lit/gpon/sn54ls373-sp>
- 74LS245- <https://www.ti.com/lit/gpn/sn54ls245-sp>
- 74LS244- <http://www.sycelectronica.com.ar/semiconductores/74LS244.pdf>
- JHD162A - <https://datasheetspdf.com/pdf-file/512991/ETC/JHD162A/1>
- 74LS138- <https://datasheetspdf.com/pdf-file/543723/ETC/74LS138/1>

